UNITED STATES PATENT APPLICATION

for

A BONDED WAFER PROCESSING METHOD

Inventors:

Patrick Morrow
R. Scott List

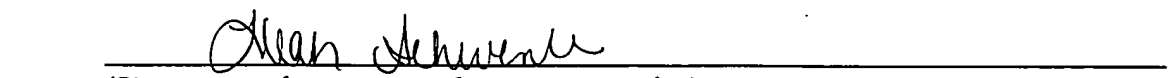
Prepared by:

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Boulevard
Los Angeles, CA 90025-1026
(303) 740-1980

File No.: 042390.P17268

"Express Mail" mailing label number EV306655092
Date of Deposit March 29, 2004
I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, P.O. Box 1450, Alexandria, VA 22313-1450

Leah Schwenke
(Typed or printed name of person mailing paper or fee)



(Signature of person mailing paper or fee)

A BONDED WAFER PROCESSING METHOD

FIELD OF THE INVENTION

[0001] The present invention relates to silicon processing; more particularly, the present invention relates to processing bonded wafers.

BACKGROUND

[0002] Three-Dimensional Structure (3DS) integrated circuits (ICs) allows for physical separation of circuits and the control logic onto different layers such that each layer may be separately optimized. Fabrication of 3DS ICs involves aligning and bonding to a common substrate a topside of a second circuit substrate, grinding the backside or exposed surface of the second circuit substrate to a predetermined thickness, and then polishing the surface.

[0003] A problem, however, often occurs during the grinding step. The wafer substrate that is to be grinded includes a bevel component that is unsupported during the grinding step of the process. Therefore, whenever pressure from the grinder is applied to thin the wafer substrate, the unsupported component may chip.

[0004] Edge chipping is considered a serious problem in the fabrication process since it may result in relatively large portions of the wafer substrate being delaminated. Delamination may potentially lead to down stream

processing inefficiencies and/or yield problems on the edge of the substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention will be understood more fully from the detailed description given below and from the accompanying drawings of various embodiments of the invention. The drawings, however, should not be taken to limit the invention to the specific embodiments, but are for explanation and understanding only.

[0006] **Figure 1** illustrates an exemplary process flow for grinding a wafer;

[0007] **Figure 2** is a flow diagram illustrating one embodiment of a bonding process;

[0008] **Figure 3** illustrates one embodiment of a wafer with a photo resist layer;

[0009] **Figure 4** illustrates one embodiment of a wafer after etching;

[0010] **Figure 5** illustrates one embodiment of bonded wafers; and

[0011] **Figure 6** illustrates one embodiment of bonded wafers after the thinning process.

DETAILED DESCRIPTION

[0012] A bonded wafer processing method is described. Reference in the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

[0013] In the following description, numerous details are set forth. It will be apparent, however, to one skilled in the art, that the present invention may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form, rather than in detail, in order to avoid obscuring the present invention.

[0014] **Figure 1** illustrates an exemplary process flow for grinding a wafer substrate. As shown in **Figure 1**, a grinding wheel thins a top wafer of a bonded pair of wafers. The bevel of the top wafer is an area that is unsupported by the bottom wafer. Thus, as the grinder asserts pressure at the top wafer, portions of the bevel beyond the unsupported area may be chipped away, resulting in the possibility of relatively large portions of the top wafer being delaminated.

[0015] According to one embodiment, a step is added to the bonding process to prevent the chipping of an unsupported area of a wafer to be thinned.

Figure 2 is a flow diagram illustrating one embodiment of a bonding process to prevent the chipping or damaging of a wafer to be thinned. At processing block 210, a photoresist layer is applied to a wafer that is to be thinned. The photoresist is applied to protect an active portion of the wafer.

[0016] **Figure 3** illustrates one embodiment of a photo resist layer 310 applied at a wafer 320. As shown in **Figure 3**, the photoresist layer is applied to the straight portion of wafer 320, which is the area before wafer 320 begins to curve.

[0017] Referring back to **Figure 2**, wafer 320 is etched after photoresist layer 310 is applied, processing block 220. In one embodiment, wafer 320 is etched using a dry etching method. However, those skilled in the art will recognize that other etching methods may be implemented (e.g., wet etching). Subsequently, photoresist layer 310 is delaminated from wafer 320.

[0018] **Figure 4** illustrates one embodiment of wafer 320 after etching and the stripping of photoresist layer 310. Notice that wafer 320 includes a bevel component 410. The bevel component 410 will be grinded off during the thinning step of the process.

[0019] Referring back to **Figure 2**, wafer 320 is bonded to a bottom wafer at processing block 230. According to one embodiment, wafer 320 is bonded to the bottom wafer via a direct bonding method. However, one of ordinary skill in

the art will appreciate that other bonding methods may be implemented (e.g., metal diffusion, anodic, etc.). **Figure 5** illustrates one embodiment of the process after wafer 320 has been bonded to a bottom wafer 530.

[0020] Referring back to **Figure 2**, wafer 320 is thinned by a grinder after being bonded to wafer 530, processing block 240. **Figure 6** illustrates one embodiment of bonded wafers after the thinning process. As shown in **Figure 6**, a grinding wheel 610 has been applied to the thinned wafer 320, which is bonded to wafer 530. According to one embodiment, the unsupported bevel portion 430 of wafer 320 is ground off during the thinning process. Thus, chipping or damage that may have occurred on the unsupported bevel portion 430 is removed without effecting the remaining portion of wafer 320.

[0021] Whereas many alterations and modifications of the present invention will no doubt become apparent to a person of ordinary skill in the art after having read the foregoing description, it is to be understood that any particular embodiment shown and described by way of illustration is in no way intended to be considered limiting. Therefore, references to details of various embodiments are not intended to limit the scope of the claims which in themselves recite only those features regarded as the invention.